

The Discovery and Early Natural History of the Eastern Pygmy-Possum, *Cercartetus nanus* (Geoffroy and Desmarest, 1817)

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Early accounts of the eastern pygmy-possum, *Cercartetus nanus* (Marsupialia: Burramyidae), are reviewed and the history of its discovery is reported. François Péron discovered the species when on a short stay on Maria Island in 1802. Various names have been conferred upon it, but *C. nanus* is now accepted. The early natural history literature on *C. nanus* has some very interesting and highly relevant accounts of morphology, distribution, behaviour, habitat and diet. Some discrepancies and misinterpretations in the early literature are identified, and several interesting 19th Century illustrations of *C. nanus* are reproduced. This study documents the significance of the primary source material pertaining to this small elusive marsupial.

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KEYWORDS: Burramyidae, *Cercartetus nanus*, discovery, natural history, nomenclature

INTRODUCTION

The eastern pygmy-possum, *Cercartetus nanus*, is broadly distributed in Tasmania and along the eastern seaboard of mainland Australia from south-eastern Queensland, through coastal New South Wales and Victoria, and into south-eastern South Australia (Strahan 1995). Currently there are two recognised subspecies: *C. nanus nanus* in Tasmania; and *C. n. unicolor* on the mainland (Wakefield 1963; McKay 1988). It is a small (~24g) and agile tree-dwelling marsupial that feeds chiefly on nectar, pollen and invertebrates within a range of habitats including heathland, woodland, sclerophyll forest and rainforest. Modern studies have documented some aspects of the population biology of this species and it is understood that it depends on the presence of a diverse range of flowering plants (particularly *Banksia* in certain areas), and that seasonal food availability influences both the timing and duration of breeding (Turner 1984, 1985; Ward 1990; Turner and Ward 1995; Bladon et al. 2002). During winter, *C. nanus* is able to store up fat in its body and tail, and can exhibit torpor (Geiser 1993; Turner and Ward 1995; Bladon et al. 2002). Pygmy-possums have a prehensile tail, which resembles that of a ringtail possum, and also syndactylous hind feet and an opposable clawless hallux (Turner and McKay 1989).

Cercartetus nanus shares the family Burramyidae with four other extant species: the long-tailed pygmy-possum, *C. caudatus*, little pygmy-possum, *C. lepidus*, western pygmy-possum, *C. concinnus* and mountain pygmy-possum, *Burramys parvus* (Strahan 1995). This paper investigates the discovery and early accounts of the natural history of *C. nanus*, which was the first of the burramyids to be formally described by Europeans (Desmarest, 1817). Subsequently, *C. concinnus* (Gould, 1845) was recognised, then *C. caudatus* (Milne-Edwards, 1877), *C. lepidus* (Thomas, 1888) and *B. parvus* Broom, 1896.

MATERIALS AND METHODS

The work of Thomas (1888) is instructive for early accounts of *Cercartetus* spp., and in this regard 36 references for *C. nanus* (and its synonyms) were provided from literature published from 1817 to 1875. The Kinetica and Firstsearch databases were used to identify libraries within Australia and overseas that held the relevant early natural history titles from which copies of the relevant articles were obtained. I also supplemented these papers by searching for mention of the species in the early volumes (<1970) of the Australian Zoologist and the Victorian Naturalist (Harris 2005). The literature was

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examined and reviewed for information on discovery, taxonomy, morphology, distribution, abundance, diet, habitat and behaviour.

HISTORICAL RECORDS

Discovery

The first specimen of *C. nanus* known to Europeans was collected by François Péron, a naturalist aboard Nicolas Baudin's voyage to the south seas on the ships *Le Geographe* and *Le Naturaliste* (1800-1804). His discoveries and observations whilst in Australia have long interested historians (Triebel 1948; Faivre 1953; Cornell 1965; Plomley 1983; Wallace 1984; Horner 1987; Plomley et al. 1990; Hunt 1999; Anderson 2001). He is credited with the collection of about 100,000 zoological specimens, 2500 of which were new to science, including *C. nanus*. Whilst on a short stay on Maria Island, off eastern Tasmania between 19 and 27 February 1802, Péron traded with the Aboriginal inhabitants (the Tyreddeme people; Ryan 1981) for a single small marsupial. Péron (1809:233) wrote (in translation) 'In the class of mammiferous animals, I only saw one kind of *Dasyurus*, which was scarcely as large as a mouse. I obtained one that was alive, in exchange for a few trifles, from a savage who was just going to kill and eat it'. In an unpublished manuscript (now held in the Le Havre Museum in France) Péron also wrote that the animal 'was given to me by the natives; it was still alive; I believe it to be a new species and have described it as *Didelphis muroides* because of its resemblance to the *D. mus* of Linnaeus' (Observations zoologiques by François Péron, on Maria Island, unpublished manuscript # 18043:31). The specimen collected by Péron (a juvenile male) was transported back to France, and is now held in the Muséum National d'Histoire Naturelle in Paris as the holotype (Julien-Laferriere 1994). *Cercartetus nanus* still presumably inhabits Maria Island, as there is a relatively recent record from 1969, when two young animals were found in a dead tree being cut for firewood (Animals and Plants Protection Board 1969).

Plomley et al. (1990) erroneously stated that the single small marsupial collected on Maria Island by Péron was the type specimen for *Antechinus minimus*. This was probably based on a similar mistake made by Waterhouse (1846) which was highlighted by Wakefield and Warneke (1963). Waterhouse (1846) interpreted Péron's statement of finding a '*Dasyurus*' as meaning that the dasyurid *A. minimus* was also collected from Maria Island, when evidently *C. nanus* was the only mammal species collected (Desmarest

1817, 1820; Cuvier 1826; Lesson 1827, 1838, 1842; Temminck 1827; Fischer 1829; Schinz 1844; Iredale and Troughton 1934; Tate 1945; Wakefield and Warneke 1963). The type specimens for both *C. nanus* and *A. minimus* were collected by Péron, but the latter is considered to have come from Waterhouse Island, which lies close to the north-eastern coast of Tasmania (Wakefield and Warneke 1963; Rounsevell 1989).

Taxonomy and nomenclature

Upon the return of the Baudin expedition to France in 1804, several of the great French zoologists of the period, including Anselme-Gaetan Desmarest and Etienne Geoffroy Saint-Hilaire worked rapidly describing and classifying the specimens collected by Péron. In the encyclopedic *Nouveau Dictionnaire d'Histoire Naturelle*, Desmarest (1817) described the small marsupial collected from Maria Island as *Phalangista nana* Geoff. (=Geoffroy). However, subsequently there has been uncertainty as to whom the specific name *nana* ('dwarf') should be attributed to, with some authors allocating it to Geoffroy (e.g. Cuvier 1827; Temminck 1827; Lesson 1828, 1830 1838; Fischer 1829; Gray 1841; Schinz 1844; Waterhouse 1846; Gunn 1852) and others to Desmarest (e.g. Giebel 1859; Lydekker 1896; Lucas 1897; Le Souef and Burrell 1926; Iredale and Troughton 1934; Wakefield 1963). McKay (1988) stated that it must be dated from Desmarest [and hence not Geoffroy] as 'Geoffroy's (1803) manuscript was never published'. However, Julien-Laferriere (1994) stated that the species is not mentioned in Geoffroy's (1803) *Catalogue des Mammifères*, contrary to what McKay (1988) allows to be assumed. Furthermore, the specimen did not arrive in France until 1804. Although Geoffroy did not write on the species, Beaufort (1966) believed that Desmarest's allocation of the name to his colleague was intentional (also see Desmarest 1820), and accordingly he proposed that it should officially be attributed to both as *Cercartetus nanus* (Geoffroy and Desmarest, 1817). In this, I have followed Beaufort (1966).

In a new edition of *Nouveau Dictionnaire d'Histoire Naturelle*, published in 1818, a description of *P. nana* equivalent to Desmarest (1817) was also published. This is significant because the 1818 edition is sometimes incorrectly referred to as the first description for the subject species (e.g. by Iredale and Troughton 1934; Marlow 1962; Wakefield 1963; Green 1974; McKay 1988; Turner and McKay 1989; Flannery 1994; Menkhorst 1995; Turner and Ward 1995). Following Desmarest (1817), brief descriptions of the species appeared in

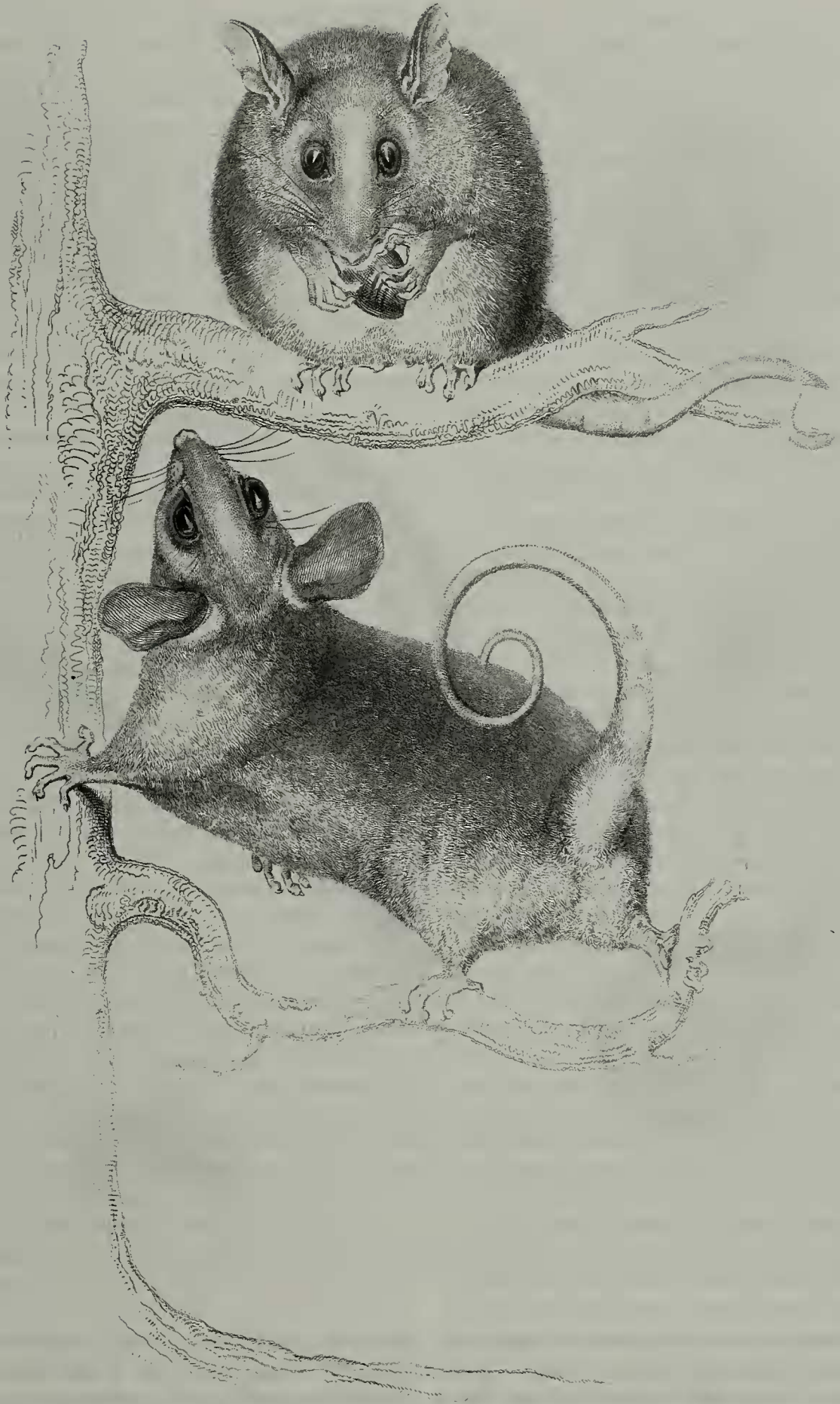


Figure 1. This illustration above of two *Phalangista gliriformis* (= *Cercartetus nanus*) appeared in an article by Thomas Bell published in the *Transactions of the Linnean Society of London* in 1829. The animals appear to be quite large due to the disproportionately small tree trunk and branches upon which they are standing.



Figure 2. Pouch and extremities of *Phalangista gliriformis* (= *Cercartetus nanus*) by Bell (1829). a. Pouch and teats, shortly after the period of suckling; b. Pouch and teats of the unimpregnated animal; c. Prehensile extremity of the tail; d. Fore-foot, upper part; e. Fore-foot, under part; f. Hind-foot, upper part; g. Hind-foot, under part; h. Curl of the tail, observed during sleep.

subsequent zoological publications printed in French (Desmarest 1820; Cuvier 1826; Lesson 1827; 1828; 1830; 1838; Temminck 1827; Fischer 1829), English (Cuvier 1827) and German (Schinz 1844) and were either taken from the original reference or from the specimen which formed the subject of it.

On 4 November 1828, Thomas Bell read before the Linnean Society of London a description of a supposed new species of *Phalangista*, which he named *P. gliriformis* (Bell 1829). The species name was derived from the latin word 'glires' meaning 'dormouse'. His address was based on close examination of two live females which were 'received from New Holland' (Australia), but from what part was not stated. Bell (1829) detailed a great deal of careful observation, but he failed to persuasively distinguish *P. gliriformis* from *P. nana*. According to the description, the distinction was proposed because of slight differences in the colouring, and principally because fur was absent from the ears. Bell's confidence in the distinction relied on the phrase 'les oreilles sont arrondies et couvertes de poils' from Temminck's (1827) description of *P. nana*, which quoted Desmarest (1817), and translates as 'the ears are round and covered with hair'. Later, Waterhouse (1841) stated that 'Temminck should have said that the ears are covered with very minute hairs, for so small are they that to the naked eye they appear naked' (see also Wagner 1843). The holotype of *P. nana* contained in the Paris Museum, and also the type specimen for *P. gliriformis*, were re-examined by Waterhouse (1841) and no specific differences were perceived by him (see also Waterhouse 1846; Wagner 1855). Despite this taxonomic oversight, Bell's observations on living specimens resulted in some very interesting notations on the habits of the species and he also provided some remarkable illustrations (reproduced as Figs 1 and 2). However, one inaccuracy in Fig. 1 (lower animal) is the inclusion of a claw on the hallux. It should be highlighted that a very similar illustration to Fig. 1 appeared in Cobbold (1868), but the hind feet were also drawn incorrectly (see reproduction of this image and comments in Strahan 1981).

There is some confusion in the literature regarding a statement made by Burmeister (1837) which translates as 'a specific genus (*Cercaertus* Glog.) is formed by the common brush tailed *Ph. vulpina*'. It has occasionally been presumed that *Cercaertus* was a mis-spelling or synonym of *Cercartetus* (e.g. Simpson 1945; Marlow 1958; Hickman and Hickman 1960; Sharman 1961; Bartholomew and Hudson 1962; Grzimek 1975). In fact, the name *Cercaertus* was used in reference to *Phalangista vulpina*, which is an absolute synonym for *Trichosurus vulpecula*, the

common brush-tail possum. According to Wakefield (1963), the reference was drawn from an unpublished manuscript written by Constantin Gloger, but when the work was published in May 1841, the name *Cercaertus* was not mentioned. Instead, Gloger (1841) proposed the quite different name *Psilogammurus* for *P. vulpina*, and used *Cercartetus* for *P. nana*. *Cercartetus* makes some reference to the tail (from the Greek *kerkos*) but the significance is obscure (Strahan 1981). It is not known whether Burmeister (1837) incorrectly cited Gloger (unpublished) or if substantial changes were made to the work prior to publication. Perhaps due to the confusion, the name *Cercartetus* was at that time basically disregarded for *P. nana*. However, it is clear that the name *Cercaertus* is a junior synonym of *Trichosurus* and not of *Cercartetus* (Iredale and Troughton 1934; Wakefield 1963; McKay 1988).

In a report dated 10 July 1841, and published in November of that year, Dr J.E. Gray of the British Museum set out a review of locality data on Australian mammals wherein he proposed the genus *Dromicia* for *P. nana* because 'the dentition and the peculiar form and character of the tail of this species, at once point out that it should constitute a distinct genus from the other Phalangiers, from which it differs in many of its habits' (Gray 1841). This was later accepted by Dr G.R. Waterhouse of the British Museum (Waterhouse 1846), and subsequently the name *D. nana* was widely applied, although the synonym '*Phalangista nana*' persisted in a small number of articles (e.g. Gunn 1852; Gulliver 1875). Cobbold (1868) reported that Professor Richard Owen, of the Royal College of Surgeons London, disagreed with Gray (1841) on the justification of *Dromicia*. Owen stated that 'modifications of the teeth are unaccompanied by any change of general structure or of habit, whilst those teeth which most influence the diet are constant' and also that 'these differences of dentition are unimportant, and afford no grounds for subgeneric distinctions'. However, in this case at least, Owen's view did not gather support.

The species was not found on the Australian mainland until Gerrard Krefft of the Australian Museum made a report of a *Dromicia* found near St. Leonards, North Shore, Sydney, New South Wales. Krefft (1863) believed it represented a new species and described it as *D. unicolor*, which was a reference to its uniform mouse-colour. However, M.R. Oldfield Thomas of the British Museum doubted the significance of the find, and believed that Krefft's *Dromicia* was probably a *D. nana* from Tasmania which had escaped from captivity (Thomas 1888). He argued that apart from Krefft's specimen, the

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species had never been recorded from the mainland, also adding the questionable statement that it is 'to be found in the collection of almost every dealer in live animals'. Thomas (1888) also remarked that he had inspected drawings of the premolars of the *D. nana* held in the Paris Museum, and compared these with Bell's *D. gliriformis*. He concluded they were synonymous, which supported Waterhouse's (1841) earlier view, although Thomas did not mention Waterhouse in relation to this.

In 1925, Frederic Wood Jones, Professor of Anatomy at the University of Adelaide, communicated some observations in the Transactions of the Royal Society of South Australia on what he believed was a new species of *Dromicia* (Wood Jones 1925). An adult male, collected at Millicent in south-eastern South Australia, was described as the type of *Dromicia britta*. Certain measurements were provided which suggested that his specimen was considerably smaller than Krefft's *D. unicolor* and the average specimens of *D. nana*. For this reason, and also because his specimen had a greyer colouration, and shorter tail than *D. nana*, Wood Jones (1925) believed that it should be given species status. It is worth noting that measurements for two *D. nana* individuals were also presented by Wood-Jones (1925), but it is, apparent that these statistics are in error since they represent data from more than two animals (see Thomas 1888). This inaccuracy may or may not have influenced Iredale and Troughton (1934) to reject the proposed specific distinction, but *britta* was nevertheless recognised by them at the subspecific level (see below).

The genus name *Dromicia* Gray had been applied for close to a century when Iredale and Troughton (1934) noted that *Cercartetus* Gloger antedated *Dromicia* by several months. They advanced the name *Cercartetus nanus* to supersede *D. nana*, which included a change in the ending of the specific name from *nana* to *nanus* to accord with the gender of the new genus (Strahan 1981). Iredale and Troughton (1934) then somewhat arbitrarily accepted three subspecies: (1) *C. nanus nanus* for Tasmania, with *P. nana* and *P. gliriformis* as synonyms; (2) *C. nanus britta* for south-eastern South Australia with *D. britta* as a synonym; and (3) *C. nanus unicolor* for New South Wales and Victoria with *D. unicolor* as a synonym.

From the type of *C. nanus* held in the Paris Museum, G.H.H Tate of the American Museum of Natural History, had the skull extracted and cleaned for study in 1937 (Tate 1945). He examined the dentition of this and other specimens in London and sought to determine whether the type of *gliriformis* was from mainland Australia (as implied by several authors subsequent to Bell 1829, e.g. Gould 1863;

Forbes-Leith and Lucas 1884) or from Tasmania (as accepted by Iredale and Troughton 1934). He compared the teeth of *nanus* (Desmarest 1817), *gliriformis* (Bell 1829), *unicolor* (Krefft 1863) and *britta* (Wood Jones 1925), but could not resolve the matter with the specimens available to him. Nonetheless, he suggested that the subspecies should be *C. nanus nanus* for Tasmania; *C. nanus gliriformis* (= *unicolor*) for New South Wales and Victoria, and *C. nanus britta* for South Australia, which was at variance from Iredale and Troughton (1934). Tate's (1945) proposal was not adopted because he failed to demonstrate unequivocally that *gliriformis* was from the mainland. However, Iredale and Troughton (1934) had not proved that Bell's specimens were Tasmanian.

The next important contribution on the taxonomy of *C. nanus* was a review by Norman Wakefield of Monash University, who discussed the distribution, habitat and taxonomy of this species and the pygmy-possums more broadly (Wakefield 1963). He revised the taxonomy insofar as reducing the number of subspecies advanced by Iredale and Troughton (1934) from three to two, because he believed that on the mainland there was only one subspecies, which was reasonably uniform and continuous in distribution from South Australia through Victoria and into New South Wales (see also Le Souef and Burrell 1918). That is, Wakefield (1963) accepted *C. n. unicolor* as the mainland subspecies, and made *C. n. britta* an equivalent synonym, while also accepting *C. n. nanus* as the Tasmanian subspecies. However, in a subsequent note, Wakefield (1970) questioned his own sub-specific assignment, stating that the four cranial specimens available to him from Tasmania were 'insufficient to demonstrate difference from or affinity with' mainland populations. Despite this, the arrangement of Wakefield (1963) has been in place for more than 40 years (McKay 1988; Turner and Ward 1995; van Weenen 2002), and this is despite the absence of any review, testing or elaboration upon which to substantiate this hypothesis.

Confusion is even greater in vernacular nomenclature. Names included dwarf phalanger (Desmarest 1817; Cuvier 1826; 1827), minute phalanger (Waterhouse 1838), dwarf cuscus (Gloger 1841), pigmy phalanger (Waterhouse 1841), Bell's *Dromicia* (Gray 1843; Gerrard 1862), opossum mouse (Gunn 1852; Bonwick 1858; Lord and Scott 1924; Tate 1945), dusky *Dromicia*, pygmy opossum (Krefft 1864), thick-tailed *Dromicia* (Krefft 1868; 1871; Le Souef 1907), mouse-like phalanger (Cobbold 1868), common dormouse-phalanger (Thomas 1888; Lydekker 1896), dormouse phalanger (Waterhouse

1846; Lucas 1890; Le Souef and Burrell 1926; Marlow 1958), common dormouse-opossum (Ogilby 1892); dormouse possum (Brazenor 1950), pigmy opossum (Le Souef and Burrell 1918), pigmy possum (Iredale and Troughton 1934; Wakefield 1963) and eastern pigmy possum (Ride 1970). A standard name finally eventuated when a committee of the Australian Mammal Society recommended 'eastern pygmy-possum' in 1980 (Strahan 1980).

Dentition and Morphology

Desmarest (1817) stated that the teeth, as far as it was possible to observe them on this little animal, appeared to be arranged like those of phalangers. Similarly, Bell (1829) stated that the incisors did resemble other species of the genus *Phalangista*, but complained of the difficulty of examining the minuscule teeth on living subjects. Owen (1845) pointed out that the species 'has only three true molars on each side of the jaw', and also that 'the last and penultimate premolars on the lower jaw are shaped like canines'. Subsequently, Krefft (1863, 1864) was able to provide the following dental formula:

I 3-3/1-1 C 1-1/1-1 P 3-3/3-3 M 3-3/3-3
Total = 36

The basic phalangerid dentition is three premolars and four molars in each row (Tate 1945), although *Cercartetus* is unusual in having only three molars in each row, and *C. nanus* has a diagnostic P_4 which is large and double-rooted (see also Smith 1971; Turnbull and Schram 1973; Green and Rainbird 1983; Menkhorst and Knight 2001).

In terms of morphology, Desmarest (1817) made a description from a spirit specimen and briefly noted it as the size of a mouse, and with a brown circle around the eyes, and imprecisely described the ears as short, rounded and 'covered with hair'. As already mentioned, it should have been stated that the ears appear nearly naked. A more articulate description was provided by Bell (1829) who stated that:

'the general form of this animal resembles that of the common dormouse; but it is larger, broader and more depressed. The head is broad across the ears, from whence it tapers to the nose, which is somewhat pointed. The nostrils are narrow, and of a semicircular form: the upper jaw, which is elongated, overhangs the under, and almost entirely conceals it. The lips are scantily covered with

soft short hair, of a whitish colour, and are furnished with four rows of long black vibrissae, the posterior ones tipped with light brown. The eyes are very large, remarkably prominent, and of a jet-black colour: the ears of considerable size, erect, totally destitute of hair, and of a uniform mouse-colour'.

In terms of colouration, the fur was first described as grey lightly frosted with a reddish tinge and white underneath (Desmarest 1817) and more simply as upper parts grey, but white underneath (Cuvier 1826; Lesson 1827; Schinz 1844; Krefft 1871). In characteristic detail, Bell (1829) stated that his living examples were:

'covered with a very soft and thick fur; the hairs which compose it being of a gray colour tipped with reddish brown, give the general hue of rufous-gray. The under parts are more sparingly covered with fur of a pale yellowish-gray colour, the yellow predominating at the sides, and especially at the throat. The general colour of the face is also yellowish, the upper and back part of the head assuming the rufous-gray colour of the back'.

Bell (1829) also noted a blackish ring around the eye, and remarked on 'a darkish ring partially surrounding the ears at the anterior part, interrupted by a distinct white spot behind each (ear)'. Krefft (1863) described the fur as 'a uniform mouse-colour lighter on the sides and beneath, with a blackish patch in front of the eye'. Gould (1863) stated that 'considerable diversity of colour exists in different individuals; in some the upper surface is nearly uniform grey, while in others a fine tawny or rufous tint pervades the same parts; and examples are constantly met with exhibiting every variety of intermediate shade'. Wakefield (1963) pointed out that the Tasmanian members of the species (*C. n. nanus*) 'have a warm brown infusion in the general body colour and are yellowish on the sides and underneath', while the mainland form (*C. n. unicolor*) 'is less brown and less yellow' (see also Le Souef and Burrell 1918).

Early naturalists noted that *C. nanus* have several features in common with other possums, such as the prehensile tail and feet specially adapted for climbing. They also noticed the incrassated base of the tail, and considered this to be a unique and characteristic



COMMON DORMOUSE-PHALANGER

Figure 3: This illustration of the Common Dormouse Phalanger (= *Cercartetus nanus*) appeared in Lydekker's Handbook to the Marsupialia and Monotremata in 1896.

attribute of this species (Bell 1829; Lesson 1830; Gray 1841; Waterhouse 1846; Le Souef and Burrell 1926). Lydekker (1896) noted the tail as 'rather long with the basal inch thickened', but the incrassation was not evident in the illustration he provided which was originally published in Waterhouse (1841) (Fig. 3). Le Souef and Burrell (1926) explained that 'when captured in summer the tail is not usually incrassated, and the animal is slender and mouse-like; but as winter approaches it becomes bulkier, the base of the tail becomes very swollen, and the appearance of the animal is very much changed' (see also Le Souef and Burrell 1918). An assessment of the female reproductive organs by Bell (1829) revealed four teats, and many subsequent naturalists concurred with this observation (Lesson 1830; Wagner 1843; Giebel 1859; Thomas 1888; Ogilby 1892; Le Souef and Burrell 1926; Troughton 1943; Wakefield 1963). However, in more recent times Wakefield (1970) reported an individual with five nipples, and Turner (1981) found that there are actually six teats, four developed and two rudimentary.

Bell (1829) noted that two toes on each of the hind feet were 'united together' (Fig. 1). This morphological feature (syndactyly) is an adaptation for fur cleansing (Ride 1978) and for an arboreal lifestyle (Hall 1987). Krefft (1863) noticed that the tongue is 'furnished with a slight brush at the tip', and he interpreted this as an adaptation for nectar-feeding. Thomas (1888) noticed that there were five large pads on each of the palms and soles. There are various other minor descriptions of morphological features outlined in the early literature, but I have only covered those of most significance.

Distribution and abundance

In the early years of European settlement of Australia it was presumed that the species was peculiar to Maria Island and mainland Tasmania (Cuvier 1827; Waterhouse 1838; Gray 1841; 1842; Gunn 1852; Gould 1845; Waterhouse 1846; Gervais 1955; Giebel 1859; Cobbold 1868). It is now clear that the species also has a broad distribution in the coastal regions of south-eastern mainland Australia

(Turner and Ward 1995). In the early years however, the specimens which reached the British Natural History Museum were mainly Tasmanian (Gray 1843; Gerrard 1862; Thomas 1888; Wakefield 1963) which probably led Gould (1863) to postulate that the species was 'abundant ...in Van Dieman's Land (=Tasmania), particularly the northern parts of the island'. Lord and Scott (1924) also suggested that it was more common in northern Tasmania. However, by the early 1960s it was considered that the species was rare in this State because of 'marked changes in vegetation' brought about by periodic forest fires (Wakefield 1963). Important early literature records for Tasmania include Hobart, Waratah, Launceston, Westbury district, and Fury Gorge near Cradle Mountain, Cloudy Bay, Mount Wellington (see Wakefield 1963), and also Maria, Bruny, Flinders, King and Cape Barren Islands (Le Souef 1929; Hickman and Hickman 1960; Wakefield 1963; Green 1969; Green and McGarvie 1971; Whinray 1971; Hope 1973). More recent Tasmanian records and a comprehensive distribution map are provided by Munks et al. (2004).

While *C. nanus* was apparently not found on the mainland prior to 1854 (Seebeck 1995), the main credit for its discovery on the continent should go to Krefft (1863), who collected a specimen at St. Leonards, a suburb of Sydney, NSW. However, it is acknowledged that Bonwick (1858) had earlier noted that 'opossum mice' occurred at Warrnambool, Victoria, but no specimen was collected. The first collected specimen from Victoria appears to have come from Western Port in 1880 (Wakefield 1963), and subsequently Forbes-Leith and Lucas (1884) accepted the species as a component of the Victorian mammalian fauna. Other very early Victorian records include specimens collected from Gembrook and Muckleford in 1886, and Mordialloc in 1887 (Wakefield 1963). Thomas (1888) was evidently unaware of these Victorian records when he dismissed Krefft's (1863) observation of the mainland occurrence of the species.

In 1896, Dr Robert Broom recorded that he found a large number of teeth and upper jaws of *C. nanus* in a sub-fossil bone breccia deposit near the Wombeyan Caves (Broom 1896). In the same year, Professor Baldwin Spencer of the University of Melbourne provided details of several specimens secured in southern Victoria (Spencer 1896). Surprisingly however, its natural occurrence on the mainland was still disputed. Waite (1904) provided details of a specimen collected at Jindabyne, NSW, but was reluctant nonetheless, to declare that the species definitely occurred naturally on the continent. Hall (1904) finally put the controversy to rest, and

responded to Waite (1904) with a convincing list of reliable mainland records. Further relatively early (<1970) locality records for Victoria include Heathcote, Blacks Spur, Sale, Avoca, Buanger, Portland, Erica, Wilson's Promontory, Mount Lock, Tamboon Inlet, Mallacoota, Whitlands, Nowa Nowa, Snake Valley, Rushworth Forest, Cape Conran, Grenville, Yackandandah and Mount Drummond (Harris 2005). A comprehensive review of more recent Victorian records is given by Harris and Goldingay (2005).

Early *C. nanus* records from NSW include those from St. Leonards in 1863 and Jindabyne in 1903, Fitzroy Falls in 1914, La Perouse prior to 1918, Royal National Park in 1925 and Bowral in 1939 (Le Souef and Burrell 1918; Wakefield 1963). Krefft (1864) stated that 'the range of this species probably does not extend beyond the east coast districts' but qualified this by noting that because it is diminutive and nocturnal 'it will be a difficult task to obtain many examples, and so define its geographical distribution with certainty'. As further information became available, Marlow (1958) was able to state that its range in NSW was 'between the Hastings River and Sydney' and extended west only to the Blue Mountains. Subsequently, Wakefield (1963) remarked that Newcastle was the northern limit of its range. However, a recent review of the distribution of *C. nanus* in NSW (Bowen and Goldingay 2000) indicates that its range in NSW extends to Grafton, Maclean and Tweed Heads and on the far north NSW coast, although most records are from the south coast and on the eastern side of the Great Dividing Range. A few scattered western records have been identified for Pilliga, Coonabarabran, Dubbo, Parkes and Molong. The scarcity of recent records in Bowen and Goldingay (2000) has led to its current recognition as a 'Vulnerable' species in NSW.

South Australia (SA) and Queensland form the western and northern limit, respectively, of the distribution of *C. nanus*. There are only a small number of records from each of these States. Wood Jones (1925) reported that the first SA specimen was discovered at Millicent, and this specimen is now held in the collection of the British Natural History Museum (Wakefield 1963). Only three specimens from this State were acquired by the South Australian Museum prior to 1997, and its status was considered rare. These records are confined to the far south-east of SA. An intensive survey of this region which targeted *C. nanus* in 1997 produced a further 27 records, and subsequently the status of *C. nanus* in SA was changed to 'Vulnerable' (under Schedule 8 of the National Parks and Wildlife Act 1972) (van

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Weenen 2002; Carthew 2004). In Queensland, the species was first discovered by Molly O'Reilly in Lamington National Park in 1936 (O'Reilly 1941). Further examples were later found in the same general vicinity (Fleay 1966; Wakefield 1970), but as far as is known, the range of *C. nanus* extends only marginally into Queensland, where it is at present paradoxically rated as 'Common' (Eyre 2004; Harris et al. *in prep*).

Diet and habitat

Bell's (1829) captive *C. nanus* (housed in London) fed 'on nuts and other similar food'. Captive animals are known to accept a range of foods including bread, cake, seed, honey, milk, cream, biscuits, lollies, fruits and insects (Lord and Scott 1924; Le Souef and Burrell 1926; Troughton 1931; Bocking 1939; Conway 1939; Hickman and Hickman 1960). In the wild, the first feeding observation was made by Krefft (1863) who saw *C. nanus* 'feeding on the blossoms of the *Banksiae*'. He later wrote that 'they live principally on honey and soft insects' (Krefft 1867). Gould (1863) stated that they feed upon the tender buds and spikes of flowers, which Ogilby (1892) and Lucas and LeSouef (1909) interpreted as meaning that *C. nanus* was phytophagous. This possum is now generally regarded as omnivorous (McKay 1988; Menkhorst 1995; Menkhorst and Knight 2001), but not herbivorous, and microscopic analysis of faeces supports the contention that a range of dietary items (particularly pollen and insects) are consumed (Huang *et al.* 1986; Dickman and Happold 1988; Tulloch 2004).

As early as 1863 it was recognised that 'of all trees it prefers banksias' (Gould 1863), an observation which is supported by modern ecological studies (Turner 1985; Ward 1990). Bowen and Goldingay (2000) and Harris and Goldingay (2005) also note its penchant for *Banksia* habitat. Early naturalists reported that 'they inhabited open wooded country', usually among banksias as well as eucalypts, angophora, grevilleas, melaleucas and other small flowering shrubs (Le Souef and Burrell 1926; Chaffer 1930a,b). While it has been recorded from both wet and dry sclerophyll forests (Marlow 1958; Green 1973; Harris and Goldingay 2005), it has been suggested that dry forests are preferred over wet forests (Wakefield 1963). However, there are both historic and more recent evidence that wet forests/rainforest is probably favoured habitat on the edges of its range in Tasmania (Green 1973; Munks et al. 2004) and in Queensland (O'Reilly 1941; Bowen and Goldingay 2000; Harris et al. *in prep*).

A little information is available from the literature about the nesting requirements of *C. nanus*. Le Souef

and Burrell (1918) found nests of this species in hollow limbs of *Eucalyptus squamosa*, *E. piperata* and *E. haemastoma*. Later, these zoologists remarked that 'they live in any convenient nook or cranny in a tree, but usually in a hollow limb protected from the weather, making their nest at an angle. The nest is composed of soft bark, which the animals sometimes have to travel a considerable distance to procure' (Le Souef and Burrell 1926). They also detailed an observation that in one case 'it was a quarter of a mile (~400m) to the nearest tree on which bark similar to that in the nest [of *C. nanus*] was found'. Nesting observations are scant, but those published include the discovery of *C. nanus* nesting in the decaying stumps of grass trees *Xanthorrhoea* spp. (Green 1969), and also in deserted bird and bat nests (Chaffer 1930a,b; Schulz 2000). Lord and Scott (1924) commented that 'Searching for the retreats of these animals is a tedious task', and that most sightings are 'from bushmen who come across them when felling and cutting up trees in the bush'. They also added that their habits 'naturally make them difficult to obtain, and it is more by accident than design that specimens are secured'.

Behaviour

Bell (1829) was in possession of living examples, and this furnished him with the opportunity to closely observe the habits of the species while in confinement. He observed that:

'in their habits they are extremely like the dormouse, feeding on nuts and other similar food, which they hold in their fore paws, using them as hands [see also Fig. 1]. They are nocturnal, remaining asleep during the whole of the day, or, if disturbed, not easily roused to a state of activity; and coming forth late in the evening, and then assuming their natural rapid and vivacious habits. They run about a small tree which is placed in their cage, using their paws to hold by the branches, and assisting themselves by their prehensile tail, which is always held in readiness to support them, especially when in a descending attitude. Sometimes the tail is thrown in a reversed direction, turned over the back; and at other times, when the weather is cold, it is rolled closely up towards the under

part, and coiled almost between the thighs. When eating they sit up on their hind quarters, holding the food in their fore paws, which, with the face, are the only parts apparently standing out from the ball of fur, of which the body seems at that time to be composed. They are perfectly harmless and tame, permitting any one to hold and caress them without ever attempting to bite, but do not evince the least attachment either to persons about them or even to each other'.

Bell's observations were wrongly attributed to John Gould by Waterhouse (1846). However, when Gould published his meticulous work *Mammals of Australia* in 1863, he made some very original remarks, an extract of which follows:

'I am sufficiently acquainted with the habits and economy of the *Dromicia gliriformis* to state that it is a strictly nocturnal animal, and that of all trees it prefers the Banksias, whose numerous blossoms supply it with a never-ceasing store of food, both of insects and sweets; if I mistake not, it also feeds upon the tender buds and spikes of the flowers. During the day it generally slumbers coiled up in some hollow branch or fissure in the trees, whence if its retreat be discovered it is easily taken by the hand; this state of inactivity is totally changed at night, when it runs over the smaller branches and leaps from flower to flower with the utmost ease and agility. This disposition is just as strongly displayed by it when kept in confinement; being so drowsy during the daytime as to admit of its being handled without evincing the least anxiety to escape, while the contrary is the case as soon as night approaches. I have also observed that during the months of winter it is less active than in the summer; undergoing in fact a kind of hibernation, somewhat similar, but not to the same extent, as the Dormouse'.

Gould provided an illustration of a pair of *C. nanus* (Fig. 4), which at that time were 'alive in the possession of Her Most Gracious Majesty at Windsor Castle', having been brought to England by the Very Reverend the Archdeacon Marriott, and set before Queen Victoria (1837-1901) as a gift. Archer (1982) later commented that 'anyone who has seen one of these utterly charming creatures struggling to wake itself up after a deep sleep in torpor will fully understand why the Queen insisted that these little colonials had to stay with her inside Windsor Castle'. Many others have also made complimentary portrayals of this little animal, such that it has been described as 'interesting', 'elegant', 'graceful', 'beautiful', 'cute', 'harmless', 'tame', and an 'endless source of interest and amusement' (Bell 1829; Lesson 1830; Waterhouse 1846; Bonwick 1858; Krefft 1863; Lydekker 1896; Lord and Scott 1924; Le Souef and Burrell 1926; Flannery 1994). They obviously fared well in Royal confinement, evidenced by their corpulence (Fig. 3), and Gould (1863) noted that these captive animals were 'inclined to obesity'. The tendency for individuals to over-eat and become fat has also been referred to by other authors (Waterhouse 1846; Thomas 1888; Le Souef and Burrell 1918; Conway 1939; Baines 1962; Bartholomew and Hudson 1962).

Early naturalists were quick to liken the species to the English dormouse (Bell 1829; Schinz 1844; Waterhouse 1846; Gervais 1855; Krefft 1871; Thomas 1888). Bell (1829) explained that the superficial resemblance is:

'shown in their nocturnal activity, the nature of their food, their manner of taking it, their attitudes and motions, no less than in many circumstances connected with their external form and characters; as, the general form of the body, the nature of the fur, the character of the feet, the prominence and remarkable size of the eyes, &c. There is, however, one very important peculiarity of the dormouse, which has not as yet been observed to appertain to our animal, and that is its hybernation'.

However, Bell (1829) was certainly mistaken in asserting that *C. nanus* does not undergo torpor, which is a significant aspect of its behaviour (see also Waterhouse 1846; Gould 1863; Le Souef 1907; Lord and Scott 1924; Hickman and Hickman 1960; Bartholomew and Hudson 1962; Geiser 1993). An amazing story was told by A.H.E Mattingley of a



Figure 4. This charming illustration of a pair of *Dromicia gliriformis* (= *Cercartetus nanus*) appeared in Gould's (1863) *Mammals of Australia*. These animals that were at that time in the possession of the Queen of England, at Windsor Castle, and subject to the excesses of royal life, became quite obese. The signature shows that it was drawn by Gould and H.C. Richter.

dormant one found while felling a dead tree in the Goulburn valley, Victoria (in Le Souef and Burrell 1926; Troughton 1943). To try to rouse it he 'hung it to a twig by its prehensile tail, but it grasped the fur of its abdomen with its paws and remained hanging and dormant, its tail automatically suspending it'. It apparently stayed in this position 'for several hours without attempting to seek a different pose'. Le Souef and Burrell (1926) further remarked that *C. nanus*:

'are the most harmless little creatures, quiet in disposition, rather slow in movement, and quite defenceless. They spend the day coiled up in their nests, coming out to feed at night. Then they become alert, running and jumping from limb to limb, making use of their prehensile tail, especially when descending from one branch to another'.

CONCLUSION

The history of European knowledge of *C. nanus* starts with its collection from Maria Island more than 200 years ago. The subsequent accounts of its biology and of its classification were made by some of the best-known professional zoologists of the 19th Century such as Desmarest, Gould, Krefft, Thomas and Waterhouse. However, important contributions on this possum were also made by lesser known researchers, naturalists and bushmen, including Bonwick, Hall, Le Souef, Mattingley and Waite. The early records and narratives are of historical importance and add appreciably to our knowledge of this species.

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